

Space Weather Technical Forecast

Issued on Thursday 7 November 2024 at 13:30 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Moderate to High solar activity. Chance of further X-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been High with an impulsive X-class flare observed at 06/1340 UTC from AR3883 in the southeast, peaking at X2.3. There have also been numerous other M-class flares, predominantly from AR3883 and also newly numbered AR3889.

There are currently nine sunspot regions on the visible disc, including one unnumbered group. The three most actively flaring regions (AR3883, AR3886 and AR3889) all lie in the southern hemisphere. AR3883, in the south-centre disc continued to slowly develop, with at least one delta spot occupying the intermediate portion of the group in which most of the growth was observed. AR3886, in the southeast also evolved slowly, with some separation of its interior spots and minor emergence of spots in the trailing portion of the group. AR3889 in the far southeast appears to be a moderately-large group with a cluster of mature spots. It is still too foreshortened in available imagery to confidently determine its magnetic configuration, but was actively flaring during the period. The remaining sunspot regions are smaller and more magnetically simple and generally either stable or in decay.

No Earth directed CMEs (Coronal Mass Ejections) were observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds as measured at L1 by ACE/DSCOVR returned to background levels following a recent fast wind enhancement from CH86/+. Speeds decreased from 460km/s to around 380km/s. Density was below average until after 07/0900 UTC when values increased to become Average. The Interplanetary Magnetic Field (IMF), Bt, was Weak (below 6nT). The north-south component, Bz, varied weakly, oscillating between positive and negative directions. Phi angle was variable and erratic with no dominant direction observed. Geomagnetic Activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 was at background to Moderate levels. The associated 24-hour fluence was well below the Active threshold, with 1.91e6 integrated flux observed at 07/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate or High activity is forecast to continue, with occasional or frequent M-class flares expected and a chance of further isolated X-class flares, with AR3883 and AR3889 considered the most likely sources.

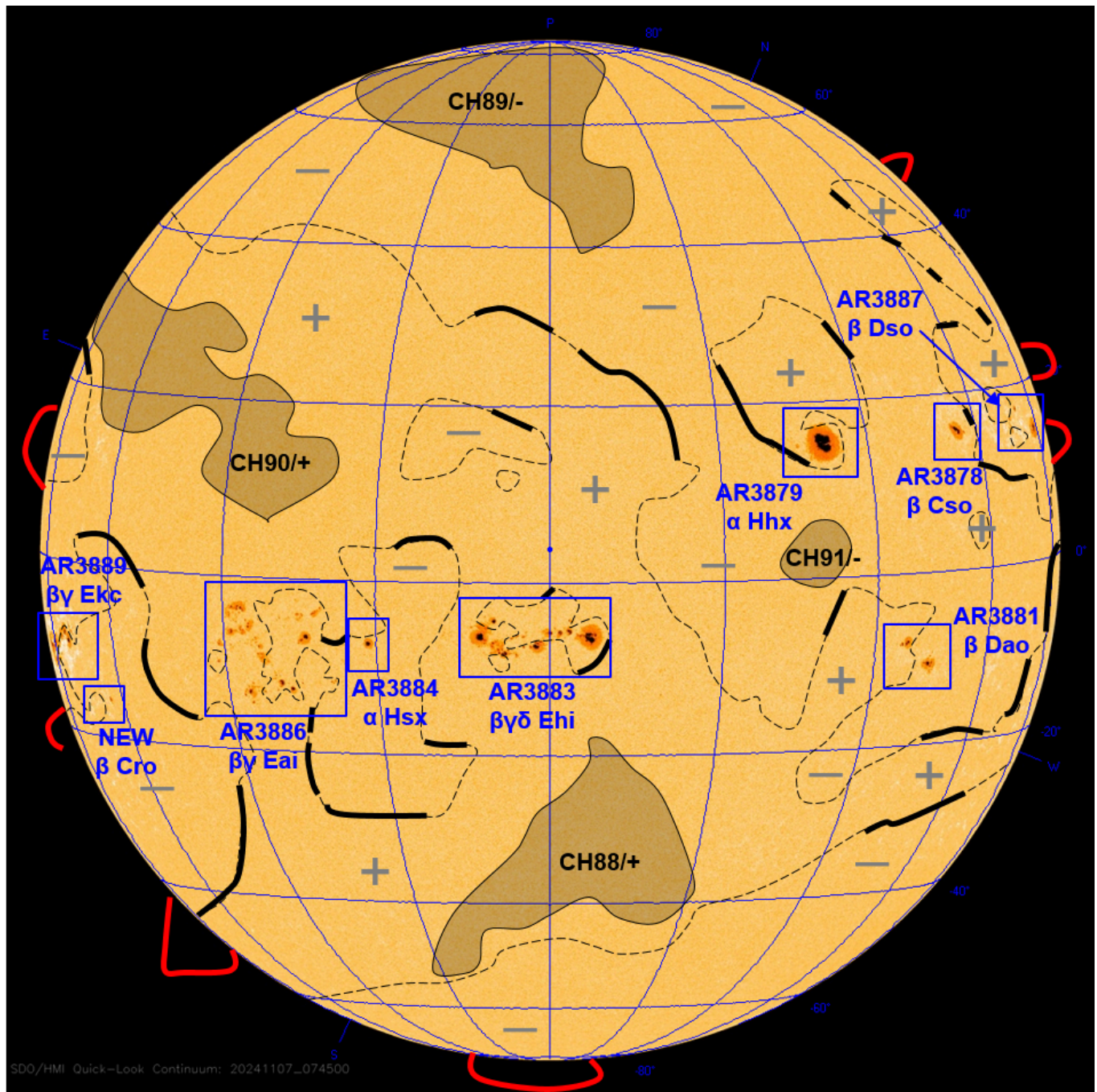
Solar Wind / Geomagnetic Activity: One or two minor CME enhancements are possible at Earth between Days 1 and 2 (07-08 Nov) but with lower than usual confidence given they are modelled as glancing impacts, at best.

Solar winds are currently at normal background levels. A weak HSS enhancement is considered likely later on Day 2 (08 Nov) or on Day 3 (09 Nov), with Slightly elevated wind speeds at peak. There is a chance for further possible HSS influence to Slight elevated or Elevated levels on Days 3 and 4 (09 and 10 Nov) from a larger but much more southerly located coronal hole.

Geomagnetic activity is expected to be generally Quiet through Day 1 and early Day 2 (07 and 08 Nov), but potentially becoming Unsettled to Active with a slight chance of G1/Minor Storm intervals depending on any potential glancing CME influences. Between Days 2-4 (08-10 Nov) activity should be Quiet to Unsettled, with a chance of isolated Active intervals.

Energetic Particles / Solar Radiation: High energy proton flux at GOES-18 is at normal background levels. There is a slight chance of S1/Minor Proton Storms or greater on day 1 (07 Nov), rising to a chance from day 2 (08 Nov) onwards as the significant regions on the facing-disc rotate into more geo-effective positions in the coming days. The high energy electron flux is expected to be mainly background to Moderate, with the associated fluence forecast to persist below Active levels.

Figure 1: MOSWOC Solar Synoptic Map valid 07/0745 UTC.



Key: Filament __, Prominence __, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Geomagnetic Storms

A CME was observed off of the east limb in association with the M3.8 flare from AR3883 at 04/0141UTC. This feature was analysed to have the bulk of the ejecta passing behind Earth's orbit. However, a faint partial halo of material (mainly shock) appears to pass the Earth-Sun line, meaning that there is a slight chance of a glancing impact from this feature during 07 Nov, though the chance of this feature affecting Earth appears to be reducing.

Solar Orbiter detected a moderate CME enhancement around 07/0400 UTC. The current location of the satellite is 7 degrees East of the Earth-Sun line at 0.71AU and therefore could provide useful insight into any potentially Earth-directed CMEs. Based on previously modelling it is considered likely that this feature is related to the lift-off associated with mid-high level C-class flaring of AR3883 around 05/0000 UTC. If this is the source of the enhancement detected at Solar Orbiter earlier on 07 Nov, then there is a chance of a flanking impact at Earth either very late day 1 (07 Nov) or more likely early day 2 (08 Nov). Confidence in this analysis is only moderate given uncertainties in the initial CME analysis and also the small, but potentially significant difference in the angle of Solar Orbiter relative to the Earth-Sun line.

The near Earth environment is at background levels following a recent minor enhancement from CH87/+. Small equatorial coronal hole CH91/- in the western disc may give some weak enhancement in solar winds later on Day 2 (08 Nov) or on Day 3 (09 Nov), but as this is a non-recurrent feature confidence is moderate. Slightly elevated solar wind speeds are considered most likely from this feature, but limited Geomagnetic effects are expected, owing to the Russell-McPherron effect and given that it is a negative polarity coronal hole. MOSWOC's ENLIL model shows a significant enhancement from HSS influence to Elevated to Strong levels from day 1 (07 Nov), but this appears unreliable, and is more likely to come from CH88/+, with a chance of connecting with Earth late Day 3 (09 Nov) or early Day 4 (10 Nov) based on current assessments of its size and location on the disc, which is at a mid-high southerly latitude.

Geomagnetic activity is expected to be generally Quiet through Day 1 and early Day 2 (07 and 08 Nov), but potentially becoming Unsettled to Active with a slight chance of G1/Minor Storm intervals depending on any potential glancing CME influences. Between Days 2-4 (08-10 Nov) activity should be Quiet to Unsettled, with a chance of isolated Active intervals.

Geomagnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	10	20	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R_☉ (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed (km/s)	Estimated Arrival Time (UTC)	Comments
2024-11-04 05:39	Partial	AR3883	SE	880	07 Nov	Likely missing Earth. Slight chance of glancing impacts.
2024-11-05 00:01	Partial	AR3883	SE	606	Late 07 or early 08 Nov	Chance of a glancing impact. Solar Orbiter (0.71AU) likely detected this CME around 07/0400 UTC.

Radio Blackouts - X-Ray Flares

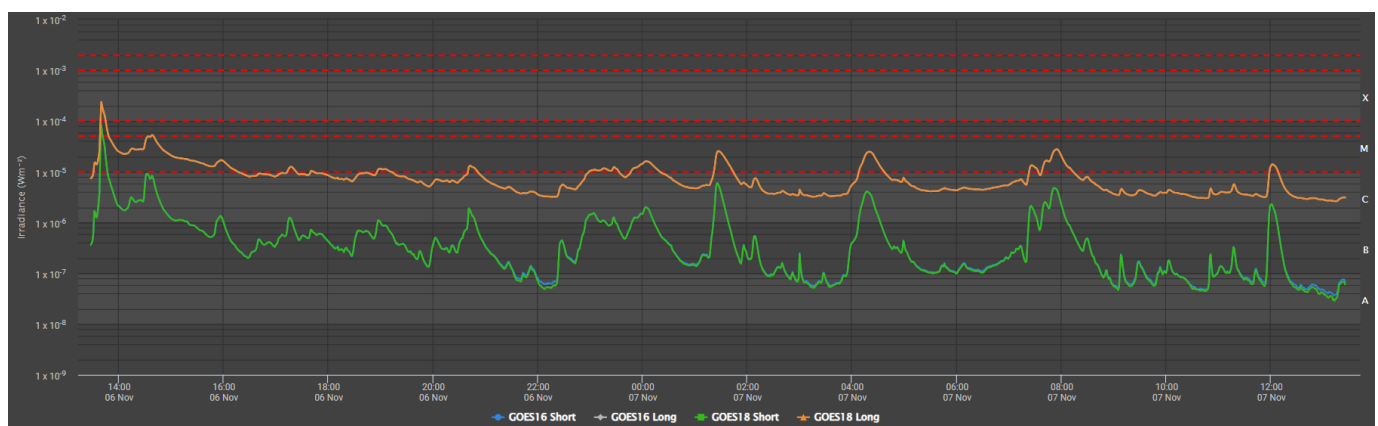
There are currently nine numbered sunspot regions on the visible disc, including one unnumbered group.

The bulk of the significant flare probabilities are contributed to by three regions, all located in the southern hemisphere. AR3883 at centre-disc continues to evolve with differential movement of the numerous intermediate spots indicating elevated magnetic shearing. Multiple M-level flare events have occurred from this region in the past 24 hours. At least one delta spot in the interior of the group persists, potentially with another two small delta spots in the formative stages of development. AR3886, to the east of AR3883, also evolves slowly, with some slight separation of its interior spots and minor emergence of spots in the trailing portion of the group. This region has been slightly less active in terms of flares. The region near the southeast limb has been numbered AR3889. It is rotating into clearer view and appears to be a moderately-large group with a cluster of mature spots. It is still too foreshortened in available imagery to confidently determine its magnetic configuration, however, based on recent flare activity it is a notable region with high potential for further significant flares. The remaining spot regions are smaller and more magnetically simple, generally either stable, or in decay.

Moderate or High activity is forecast to continue, with occasional or frequent M-class flares expected and a chance of further isolated X-class flares, with AR3883 and AR3889 considered the most likely sources.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	90	90	90	90
Very Active	R3-R5 (X Class)	Yes	25	25	25	25

Figure 2: Latest GOES16/18 X-Ray Flux trace



Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES-18 is at normal background levels. Many of the notable sunspots that currently occupy the facing-disc are currently located in centre disc or the eastern hemisphere. There is a slight chance of S1/Minor Proton Storms or greater on day 1 (07 Nov), rising to a chance from day 2 (08 Nov) onwards as the significant regions rotate into more geo-effective positions on the visible disc in the coming days.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	15	20	20	25
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = cm ⁻² sr ⁻¹ s ⁻¹)						

High Energy Electrons ($\geq 2\text{MeV}$)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background to diurnally Moderate levels and expected to persist mainly at these levels through the period. There is a chance of reaching High levels by Day 3 or 4 (09 or 10 Nov).

The associated 24-hour fluence is expected to remain well below Active throughout the period with MOSWOC REFM output considered good guidance.

GEO Electron Environment	Level ($\text{cm}^{-2}\text{sr}^{-1}\text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	1	1
Very Active	$\geq 2\text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 3: Latest GOES16 $>2\text{MeV}$ Electron Flux (above) and MOSWOC REFM forecast and Recurrence (below)

